HR - 320

INSTRUCTIONS MANUAL

HR-320 SPECTROGRAPH/MONOCHROMATOR OPERATOR'S MANUAL

I. Introduction:

1.1 The HR-320 Spectrograph/Monochromator is a rugged, compact instrument which is specifically designed to be operated in the following modes:

-Spectrograph for use with a vidicon or any solid state detector;
-Spectrograph for use with a Polaroid camera back;
-Scanning monochromator with PMT detectors;

Its basic design offers outstanding performance typical of large monochromators.

1.2 Unpacking and Shipping:

The HR-320 is shipped in cartons specifically designed to reduce the possibility of damage in transit. If the carton is damaged or after unpacking, any signs of damage become apparent, a claim should be filed with the carrier immediately.

It is recommended that the carton and packing materials be saved for future storing or shipping of the instrument. If the instrument must be returned, contact Instruments SA, Inc. for prior approval. When returning the instrument to the factory, give a full description of the reason for return. If a malfunction is involved, try to describe the difficulty clearly and concisely. When shipping the instrument, repackage in the original carton, or make sure that enough padding material surrounds the instrument to prevent damage during shipment.

Upon receipt of approval for return, ship via UPS or other carrier PREPAID to the Instruments SA, Inc. factory (see cover for address).

1.3 Instrument Identification:

Check the identification numbers on the grating and verify that the groove density and the instrument serial number match that which is on the monochromator. Contact Instruments SA, Inc. immediately if these numbers are not the same.

II. General:

2.1 Optical Diagram -

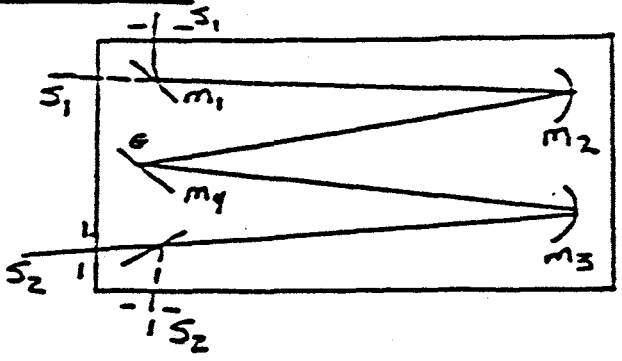


FIGURE I

The light beam enters through the entrance slit S_1. The beam is then reflected by the collimator mirror M_2 which renders it parallel and directs it to grating G. The grating diffracts the light and sends a collimated spectrum to M_3 which focusses an image of the entrance slit at S_2. Wavelength scanning at the exit slit plane is accomplished by rotation of the grating.

2.2 Resolution:

Resolution can be expressed in two forms:

-the width of the narrowest bandpass $\Delta\lambda$ that can be isolated at wavelength λ.
-the resolving power - $R = \frac{\lambda}{\Delta\lambda}$

2.3 Diffraction:

Theoretical resolving power of a grating is

$Ro = kN$ Where K = order of diffraction
N = number of grooves engraved on the total area of the grating

It is assumed that the true resolving power R of a grating is one half the theoretical resolving power Ro:

$$R = \frac{k}{2} N$$

Examples:

-A grating 68mm in width with 1200g/mm, working in the first order has a practical resolving power:

$$R = \frac{1}{2} 68 \times 1200 - 40,800$$

-A grating 68 mm width with 600 g/mm working in the first order, has a practical resolving power:

$$R = \frac{1}{2} \times 68 \times 600 = 20,400$$

3. Sine Law - Wavelength Movement :

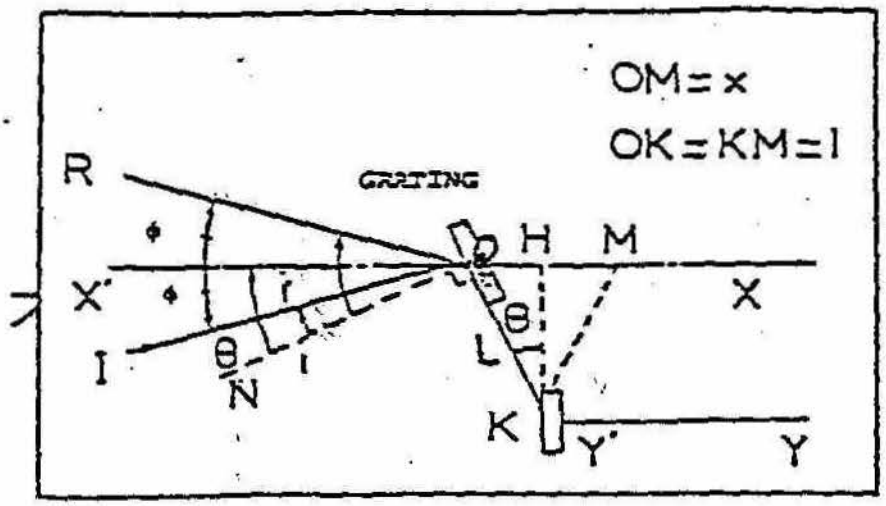


FIGURE 2

The grating diffracts the light in accordance with the sine law -

$$\sin \alpha + \sin \beta = Nk\lambda \qquad (1)$$

where α : angle of incidence
β : angle of diffraction
N : grating spacing
K : order
λ : diffracted wavelength

If 2ϕ is the angle between the incident wave and the diffracted wave,
If θ is the angle between the axis of symmetry X'X of the unit and the line perpendicular to the grating,
formula (1) can be written:

$$\lambda = \frac{2N}{k} \cos \phi \cdot \sin \theta \qquad (2)$$

Assuming, now, two equal lengths OK and KM such that -

O on the rotational axis of the grating
OK be parallel to the grating plane
M moves along the monochromator axis of Symmetry X'X

If X the abscissa of M relative to O,
it can be seen that

$$\sin \theta = \frac{X}{2L}$$

hense $$\lambda = \frac{1}{k} \frac{N}{L} \cos \phi . X$$

Mechanically, point K rests on a plane which moves along the Y'Y parallel to X'X.

A constant coefficient of proportionality exists between and Y.

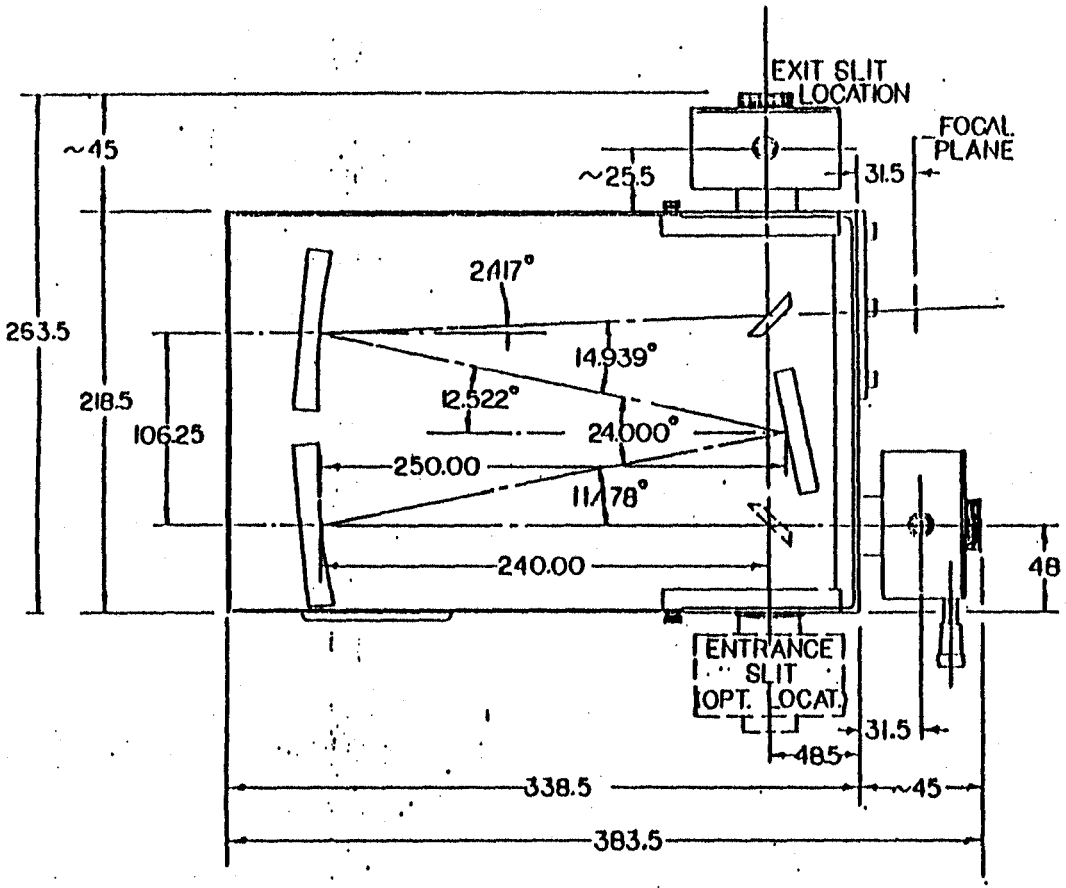
Practically speaking, for a 1200 g/mm grating working in the first order, the following equation is obtained:

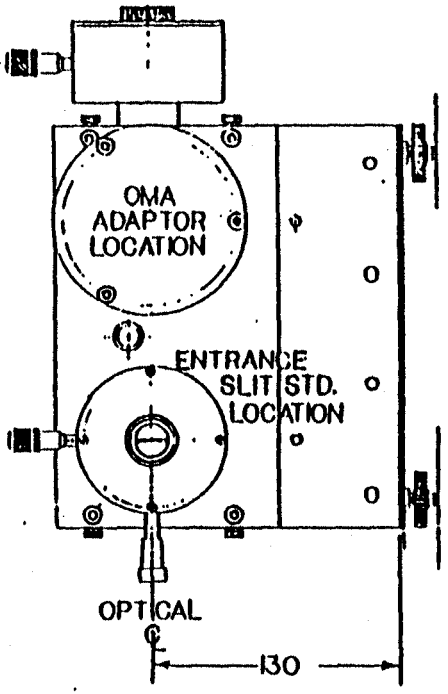
$$\lambda \text{ Å} = 200.y_{mm}$$

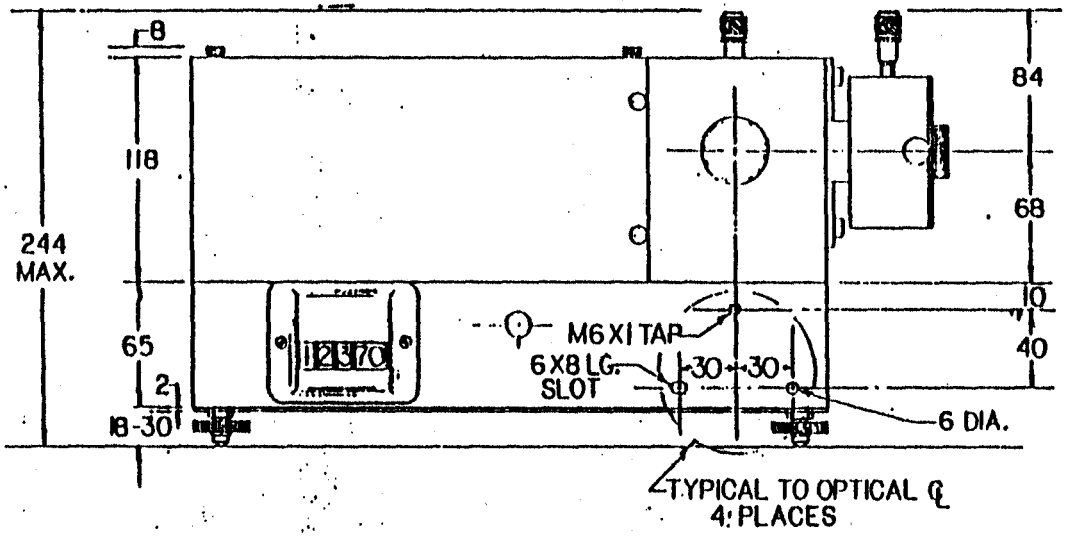
Therefore, it suffices to know the value of y to identify the wavelength. A linear variation of y results in a linear variation of the wavelength.

4. Specifications:

Focal length	0.32 meter coma corrected Czerny-Turner configuration
Aperture	F/4.2 or F/5.0 depending upon the grating size
Gratings	68x68mm Kinematically mounted 58x58mm Kinematically mounted
Dispersion	25Å/mm w/a 1200g/mm holographic grating. Other holographic and ruled gratings are available in densities from 30-3600g/mm.
Spectral Range	0-1.2 micron with 1200g/mm grating and out to 50 micron with a 30g/mm grating.
Resolution	0.4Å with 58x58mm 1200g/mm grating at 5460Å.
Stray light rejection	10^{-5} at 10Å from 6328 Å laser line.
Wavelength Display	Reads to 0.2Å direct with a 1200g/mm gratin
Scanning Speeds	.1 to 1800 Å/min with a 1200g/mm grating.
Slit dimensions	Variable = continuously adjustable from 2mm (w) x 8mm (h). Fixed = interchangeable slit inserts.
Axial entrance or Lateral exit	Optional
Nitrogen Purge	Optional.
Size	Length = 340mm Width = 219mm Height = 183mm
Weight	14 Kg/ 30 lbs.







REV	ZONE	DESCRIPTION	DATE	BY	APPR
DIMENSIONS METRIC UNLESS OTHERWISE NOTED					
DEC 00 .01	METRIC				
DEC .000 .005	FRAC 1/64				
	ANG 1 DEG				
DRWN	DATE				
CHKD	DATE				
SCALE 1/2					

TITLE: HR 320 OPTICAL PLAN & INSTALLATION

MODEL NO

APPROVED FOR PROD

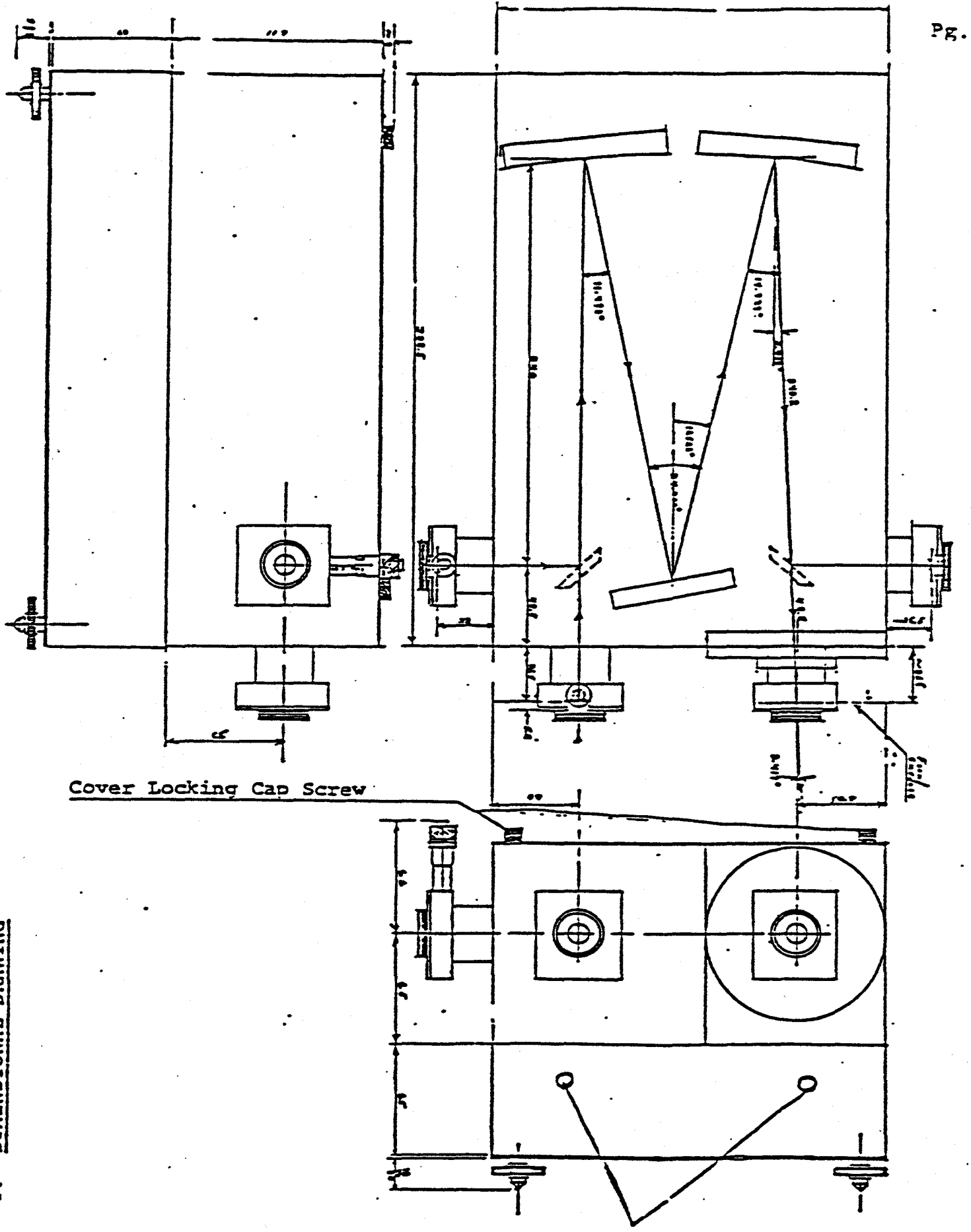
PART NO

Instruments SA, Inc.

INSTRUMENTS SA, INC.
173 ESSEX AVENUE
METUCHEN, NEW JERSEY

DWG NO | SHEET OF | REV

5. DIMENSIONAL DRAWING



Black Cap For Access To Setscrew. for Mirror

6.1 Checking out the HR-320-

It is recommended that the following procedures be followed to check out the monochromator before you attempt to use it.

A. Inspect the exterior of the monochromator for any noticeable defects. If any are present, contact ISA, Inc. immediately.

B. Unlock the wavelength dial by pushing the lever underneath the dial to the left.

C. Turn the dial to see that it moves smoothly, and that the mechanical stops are outside the operating range of the monochromator.

D. Remove any caps or coverings on the entrance and exit ports and slit holders.

E. Hold a mercury pen lamp up to the entrance slit while turning the wavelength dial. At approximately 000, an image should appear. As you turn the dial various colors of light should become visible. Representative wavelengths of colors: 410nm - violet, 470nm - blue, 520nm - green, 580nm - yellow, 600nm - orange, 650nm - red. (With a 1200g/mm grating).

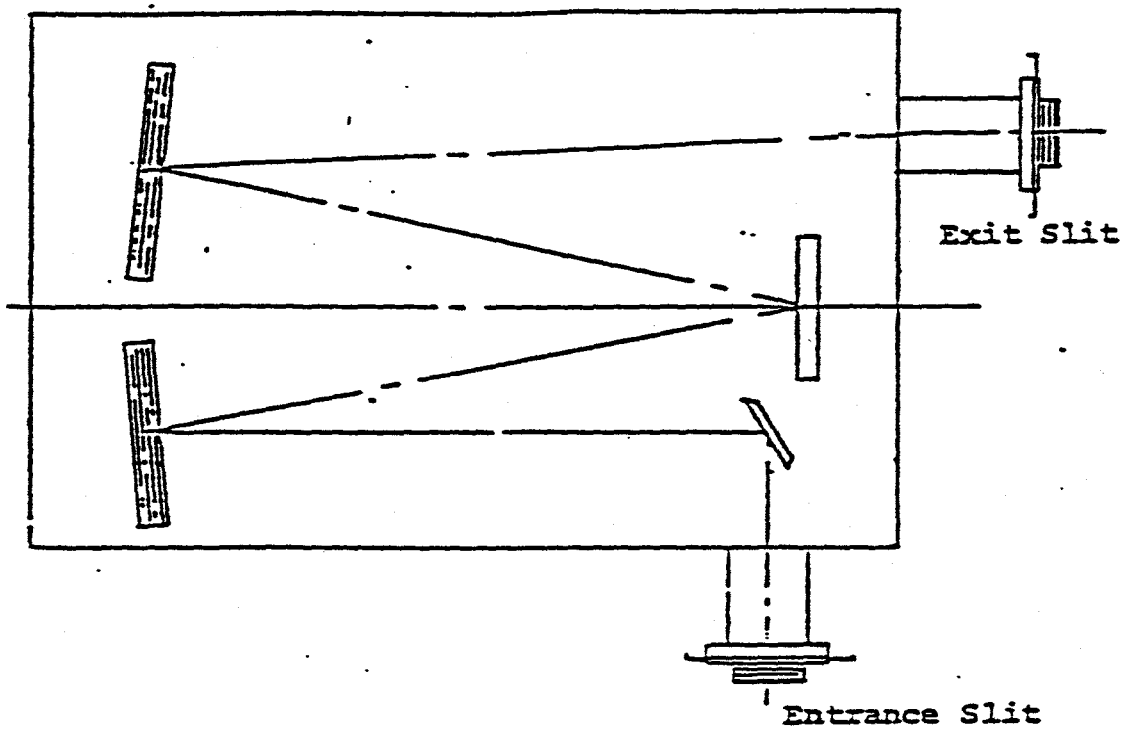
CAUTION: Do not look directly into the exit slit of the monochromator as the UV radiation may be harmful.

If any of the above procedures indicate that there is a problem with your HR-320, contact Instruments SA, Inc. as soon as possible. Please note that any attempt to repair the instrument without first consulting the factory may void the warranty.

6.2 Slits:

The HR-320 can be equipped with fixed or variable slit assemblies. Either assembly is mounted to a slit bracket which bolts directly to the base casting.

The HR-320 can be equipped with either axial or lateral entrance and exit ports. The standard configuration consists of a lateral entrance slit and an axial exit slit.



STANDARD OPTICAL CONFIGURATION

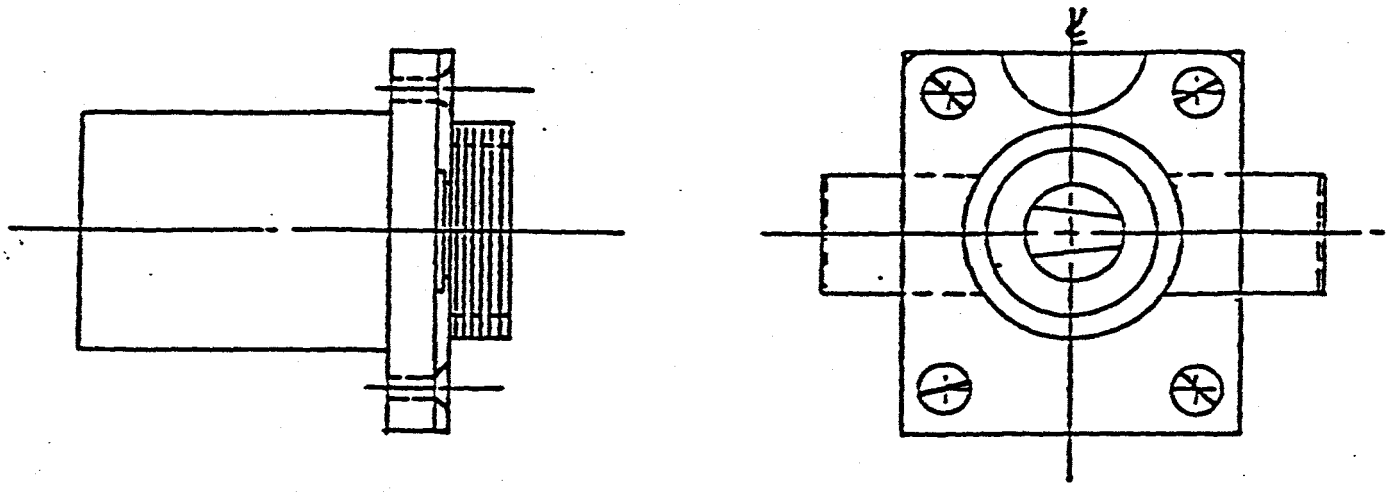
Figure 3

6.2 Fixed Slits:

The fixed slit assembly consists of a slit housing which fits into a slit support bracket. Fixed slit inserts slide into a slot in the slit housing. The standard slit inserts include:

0.012 mm
0.05 mm
0.1 mm

Various other slit widths are available upon request.



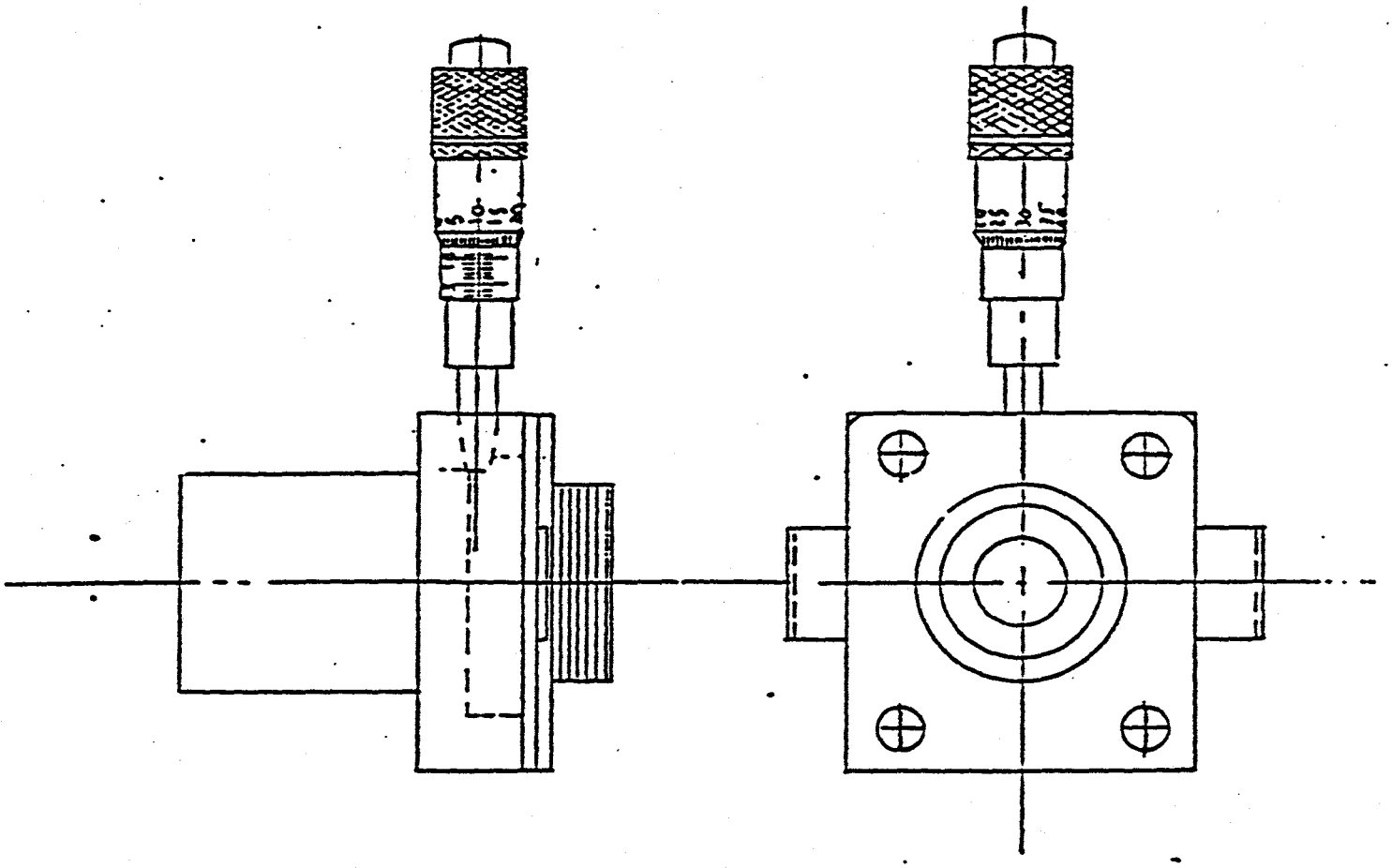
FIXED SLIT

Figure 4

6.2b Variable Slits:

The variable slit assembly consists of a slit housing which fits directly into a slit support bracket. The slit housing is comprised of many delicate precision machined components which includes the slit blades. Great care should be used when operating slits as to maintain optimum performance.

The slits open from 0-2mm in width by a micrometer spindle adjustment. Each small division on the micrometer spindle corresponds to a 5 micron movement of the slit blades. One large division on the micrometer shaft equals a 250 micron slit width.



VARIABLE SLIT

Figure 5

The micrometer spindle should rotate freely and the slit blades should open and close smoothly and evenly. If the slits do not operate properly, contact Instruments SA, Inc. immediately.

6.3 Counter:

There is a lock below the wavelength dial. The dial should turn smoothly when the lock lever is to the left and not at all when it is to the right.

The dial is direct reading in angstroms with the smallest increment equal to 0.2 Å. The HR-320 is calibrated and reads direct for a 1200g/mm grating. For other gratings, the conversion for wavelength is indirectly proportional to the groove density. The following are some examples:

Groove density	X Factor	Smallest Increment
2400	0.5	0.1 Å
1800	0.67	0.13 Å
1200	1	0.2 Å
600	2	0.4 Å
300	4	0.8 Å

6.4 Grating Installation and Change:

The HR-320 can accept both ruled and holographic gratings. These gratings are easily interchangeable as they are Kinematically mounted in the instrument. All the gratings are prealigned in there mounts prior to installation.

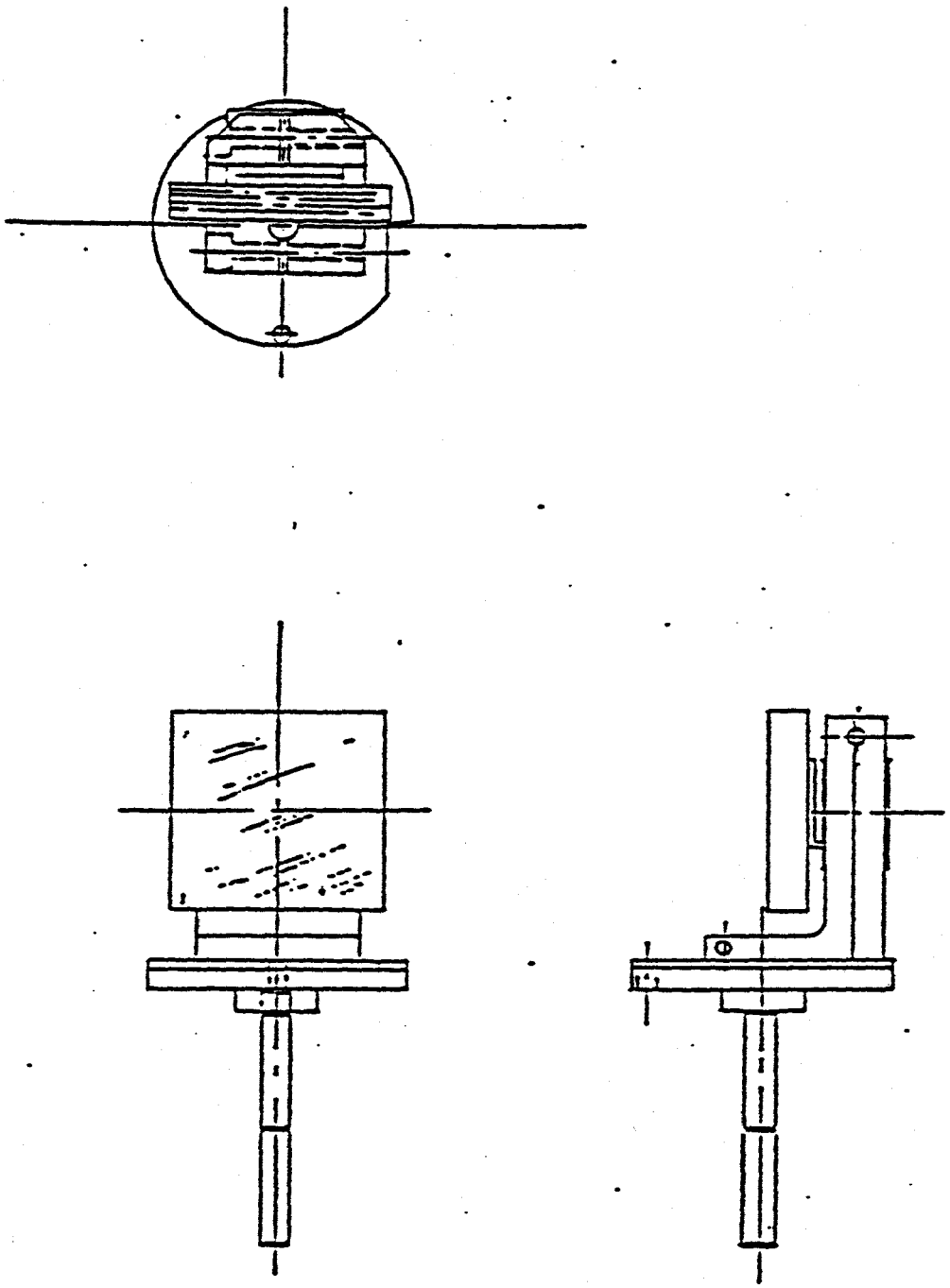
The gratings are shipped in their own case which identifies the grating number, groove density and serial number of the monochromator.

Removal of Grating -

1. Remove cover of the monochromator (see section 7.2).
2. Remove the bolt in front of the grating -
   (Caution: take great care not to touch the grating with any object.)
3. Remove the grating in the mount and place it in the grating case.

Installation of Grating -

1. Place the grating and its mount into the grating platform.
2. Turn the mount until the notch in the locking collar hits the set pin in the platform.
3. Replace bolt in front of the grating.
4. Tighten down on the bolt to secure the grating in the instrument.



GRATING MOUNT

Figure 6

6.5 Lateral entrance and exit mirror:

The HR-320 can be equipped with lateral entrance or lateral exit ports. Lateral ports require a lateral plane mirror which is mounted in the monochromator.

The mirror sits on a bolt shaft which fits into a machined slot in the monochromator base. During calibration, the mirror is properly positioned through a laser alignment. Once in position, the mirror is locked in place by a set screw located on the face of the monochromator. (see diag. 1). To assure accurate repositioning of the mirror, if removal is necessary, there is a locking collar located at the base of the shaft. The shaft and collar is rotated until it hits a locking pin on the cast of the HR-320. Once in position it is tightened in place by a set screw.

Caution: Do not remove this collar for any reason, as it will miss-align the mirror positioning.

If a lateral exit is ordered with your system, the lateral mirror will be positioned and locked into place.

Removal of the lateral mirror:

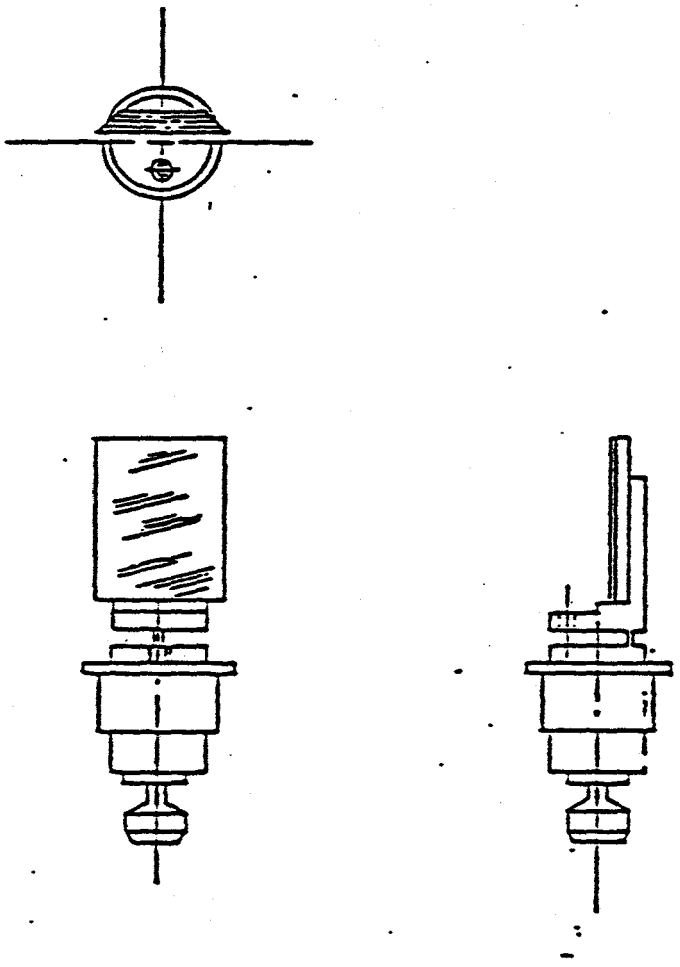
When switching from lateral to axial entrance or exit ports, removal of the mirror is necessary. The following procedure will insure proper removal:

1. Remove the cover of the monochromator (see section 7.2)
2. Remove black cap on the outside of the monochromator base. this will allow access to the mirror shaft set screw. (see diag. 1).
3. Loosen set screw with an Allen wrench.
4. Rotate mirror shaft.
5. Lift the mirror assembly out of the instrument and place it in a dust free area.
6. Replace cap on outside of monochromator.
7. Replace monochromator cover.

Caution: Do not touch mirror surface.

Installation of Lateral Mirror:

1. Repeat steps 1 and 2 above.
2. Place mirror shaft in slot. When placing mirror shaft in slot, rotate the mirror assembly until the locking collar hits the positioning set pin.
3. Tighten down on set screw.



MIRROR MOUNT

Figure 7

4. Replace all light seal caps.

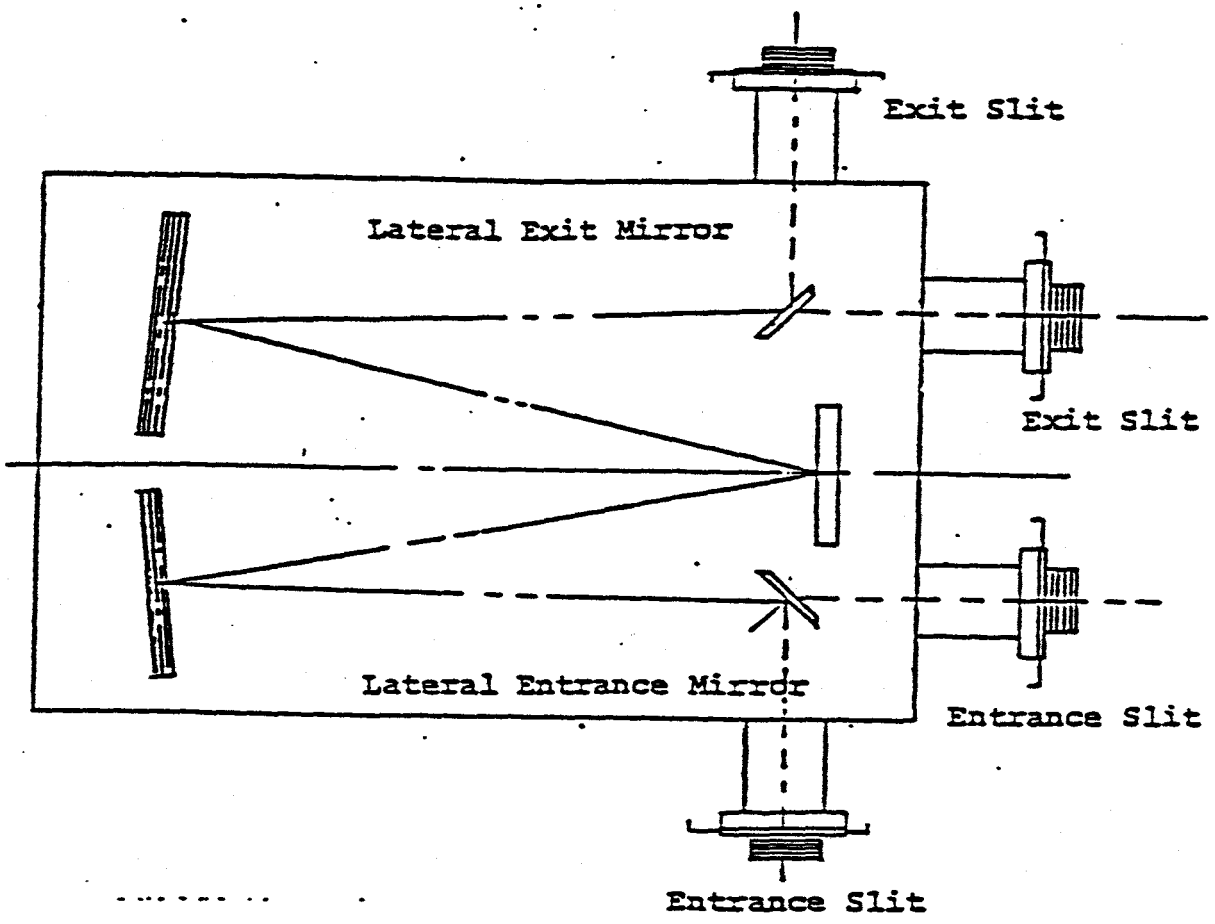


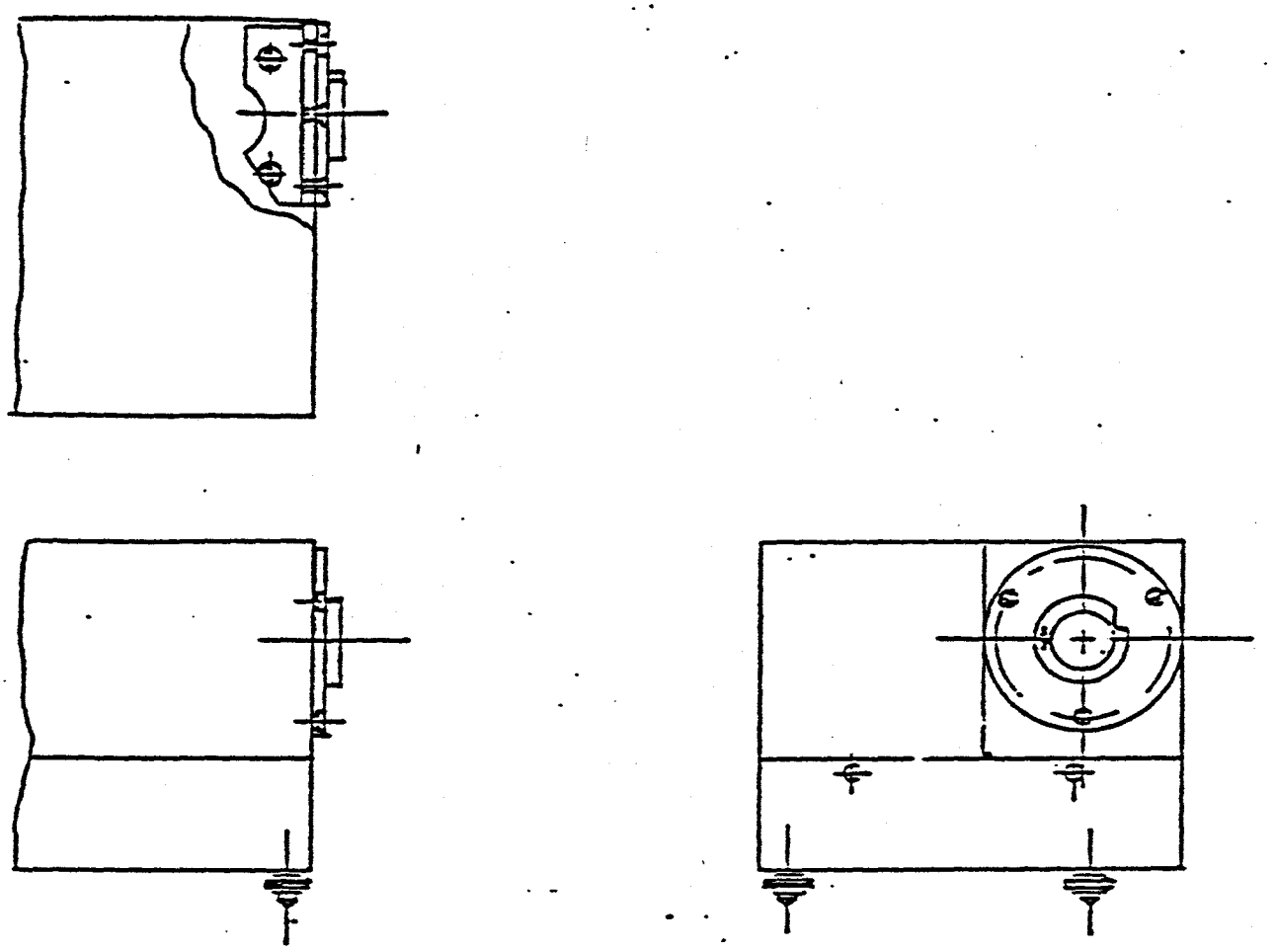
Figure 8

6.6 Scanning Mode to Spectrograph Mode:

The HR-320 can be used as a spectrograph or as a scanning monochromator. Switching from one mode to the other is easily performed.

When the instrument is used with a PMT, a slit housing is used. The slit is locked in place by a collar which sits on a circular plate. This plate has three bolts which connect to a slit or OMA support bracket. To remove the slit housing, removal of these bolts is necessary. Once the bolts are loosened, the slit and circular plate will slide off the support.

Caution: Do not remove the slit housing by itself, as the slit alignment will be lost.

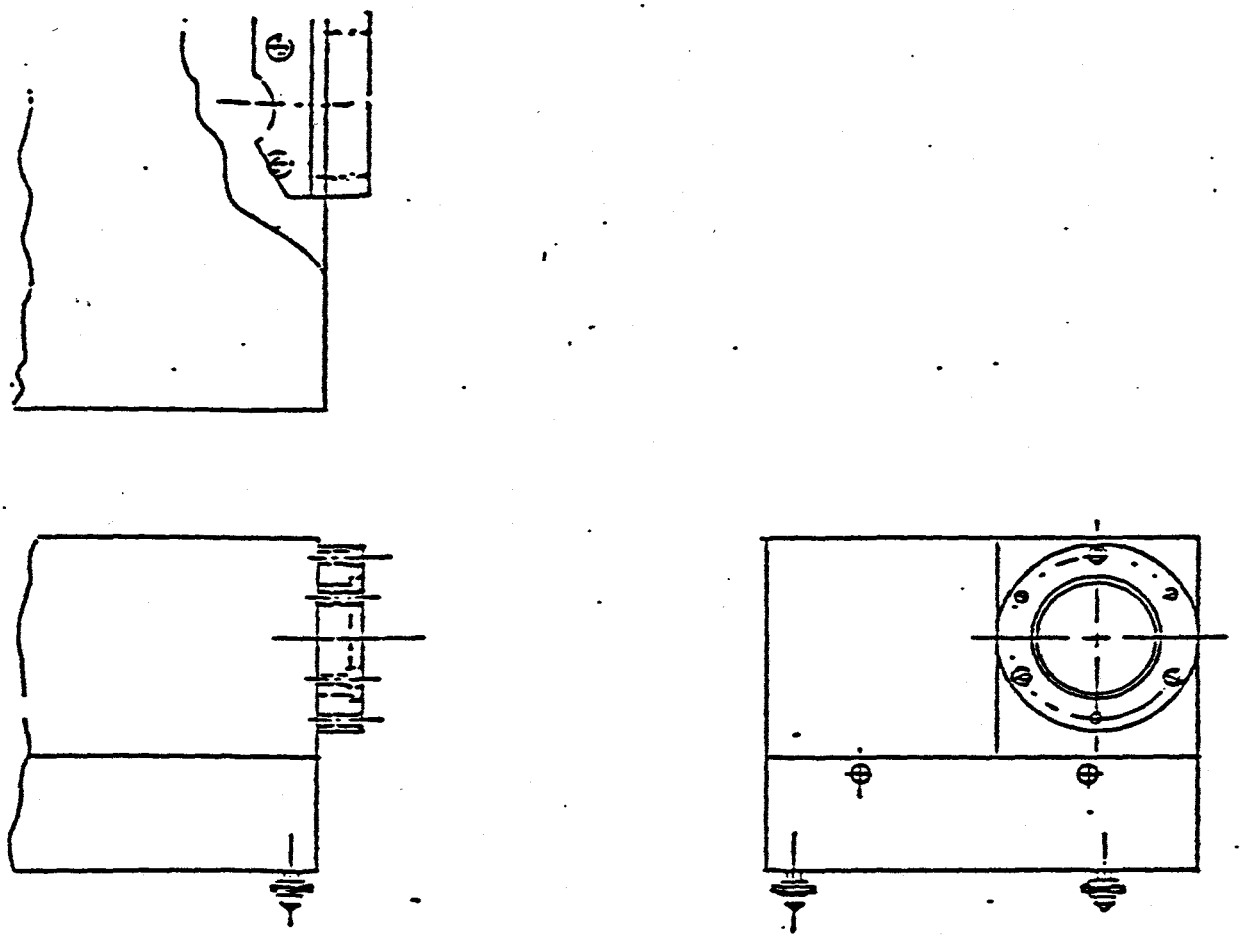


SLIT MOUNT

Figure 9

To switch from scanning mode to spectrograph mode, the OMA adaptor is necessary. This is part # 320-04.

Position the OMA adaptor for an uncooled detector such that the three holes in the adaptor and the support line up. Tighten the OMA adaptor to the support bracket.



OMA MOUNT

Figure 10

6.7 General:

Performance studies have shown that when a light source is used with the HR-320, optimum throughput, resolution and stray light rejection is achieved when the source image is focussed at the entrance slit. In addition, the optics used to focuss the light source should match the aperture of the HR-320 (F/5.0, F/4.2).

When using the HR-320 with a laser, a lens should be used to assure that the entering beam fills the grating for maximum efficiency.

7. Maintenance:

7.1 General:

An HR-320 does not require any regular maintenance under normal conditions, and may never require service. Do not hesitate to call or write Instruments SA, Inc. if anything seems to be wrong with your HR-320. Describe all symptoms specifically. Do Not attempt to correct any problem during the warranty period without factory authorization, as the warranty will be void.

Caution: The optical surfaces of the grating and mirrors are easily damaged. They may never be touched with any objects. The optical surfaces of the HR-320 are carefully inspected before shipment, damages to the surfaces will not be covered under warranty.

7.2 Removing the Cover:

When changing gratings or changing from axial to lateral exits, it will be necessary to remove the top cover of the monochromator.

The cover of the HR-320 is securred by four cap-lock screws located at each corner of the instrument. These cap screws rotate 90° to be either in the locked or unlocked position.

When the cover is locked in place, the cap screws will be perpendicular to their cap seats. To unlock the cover, rotate the cap-screws 90° such that they are parallel to their cap-seats.

7.3 Alignment:

Complete alignment of the HR-320 is a very tedious and delicate procedure. We recommend that you do not attempt to align the HR-320.

If you have any questions about the alignment procedure, please contact the HR-320 Product Manager at the ISA facility.

7.4 Calibration:

If the wavelength counter shows a constant error (+ or -) with reference to a light source of known wavelengths and the error exceeds tolerance, the counter must be calibrated.

Remove the plastic snap fitted cover from the wavelength dial. Loosen the two set screws (1.27mm hex key) on the counter shaft. The grating is rotated into a known position relative to a reference line, by turning the drive shaft sticking out of the back of the HR-320. The counter is set to the corresponding value and locked in place. The set screws are tightened while the end of the drive shaft is held to prevent rotation. The calibration is then rechecked and the procedure repeated if necessary.

8. Microprocessor Scan System:

8.1 Step Size:

The HR-320 can be equipped with a stepping motor which receives 1000 pulses per rotation. The lead screw of the HR-320 equals *100 Å per rotation. Therefore, one pulse from the stepping motor equals 0.1 Å.

Stepping motor	= 1000 pulses/rotation
Lead screw	= 100 Å/rotation
1 Step	= 0.1 Å

* with a 1200 g/mm grating.

8.2 Stepping Motor Installation:

If you have ordered the optional Microprocessor Scan System you will receive a Stepping Motor System, Controller and the Computer Interface. It will be necessary to install the Stepping Motor.

1. Remove the small plastic bag containing two hex keys and a two-piece shaft coupling that is tucked in the hole of the motor housing.

2. Attach the metal portion of the shaft extending from the rear of the monochromator. Tighten with the smaller hex key.

3. Place the plastic bushing onto the shaft coupling installed in step 2.

4. Using the larger hex key, bolt the motor housing onto the monochromator. Be sure that the plastic bushing meshes with the drive coupling on the motor.

8.3 Scan Speeds:

The Microprocessor Controller has a maximum output of 18000 pulses/min. A step size 0.1Å will give a maximum scan speed of 1800 Å/min.

What ever scan speed is entered into the memory of the controller, ten times that amount of pulses will be sent to the stepping motor.

Example:

1. Enter: 500 as scan speed
2. 500 x 10 = 5000 pulses/min. sent to stepping motor.
3. 5000 x 0.1 Å (step size) = 500 Å/min.
4. Scan speed = 500 Å/min.

Example: Maximum scan speed

1. Enter: 1800 as scan speed
2. 1800 x 10 = 18000 pulses/min
3. 18000/min x 0.1 Å = 1800 Å/min. maximum scan speed

Any entry up to 1800 as a scan speed will register—any amount greater than this will be considered as a maximum input.

8.4 Function Descriptions for Front Panel Controls:

A. Displays -

1. LED "Wavelength" Display - This digital display performs two functions. During scanning it indicates the current wavelength. When any of the keys λ, λ_1, λ_2, SPD or CYL are pressed, the value in the appropriate register will be displayed and new data may be entered. (No. 1 on diagram 2).

2. LED "Cycles" Display - This digital display indicates the number of cycles remaining to be scanned during cyclic or repetitive scanning. (No. 2 on Diagram 2)

3. LED Functions Lights - These four LED's indicate the status of the scan in progress. "FWD" and "REV" indicate in which direction scan is proceeding, forward or reverse respectively. "RUN" and "STOP" indicate whether the microprocessor is in scan or stop modes, respectively. NOTE: The "STOP" light will be lit whenever the controller is in the "Backlash Correction" mode, even though the motor may still be running. (No 3 on diagram 2)

B. Black Numerical Keys - These keys, numbered 0 to 9, are used for entering into the microprocessor memory, the various user programmable scan functions. (No 4 on diagram 2)

C. Register Keys:

1. "CLR" Key - This key clears the individual register which is punched directly preceding the use of the CLR button. e.g., Pressing λ_1, then CLR will clear the λ_1 register. This key should be used whenever you wish to enter the data into any register. (No 5 on diagram 2)

2. λ Key - This key enables the user to initialize the controll to read the same wavelength as the monochromator. Data should be entered in the format 00000.0, with the numbers moving across the display to the left as each additional digit is punched in. e.g., Monochromator dial reads 2537.0. Press λ, then CLR to clear the register, and then the keys 2, 5, 3, 7, and 0. Note: If the digit after the decimal point is to be a 0 (zero), the zero must be explicitly keyed in to hold the decimal point in the correct position. Leading zeros need not be keyed in explicitly. (No 6 on diagram 2)

3. λ_1 Key - This key allows data to be entered in the λ_1 register, which functions as the lower wavelength limit in the scan range. Digits should be entered in the same format as for the λ key. (No. 7 on diagram 2)

4. λ_2 Key - This key allows data to be entered in the register, which is the upper wavelength limit in the scan range. Digits should be entered in the same format as the λ key. (No 8 on diagram 2)

5. SPD - This key allows the user to enter the desired scan speed into its register. The maximum speed allowable is 1800 Å/min for the HR-320. Keying in numbers larger than these will result in a default to these maximum speeds. Dat should be entered in the following format: XXX with no decimal point. (No 9 on diagram 2)

6. CYL - The CYL key allows the user to enter the desired number of scans for repetitive or cyclic scanning into the corresponding register. Maximum allowable number of cycles is 99. (No 10 on diagram 2)

D. Control Keys/Switches:

1. STP - This key will cuase the system to stop, after first performing a backlash correction. This will cause the system to appear to run after the STP key has been pressed. The system will return to the exact wavelength that it was a when the STP key was pressed. NOTE: This key will not function when the controller is already in the backlash correction mode. (No.11 on diagram 2)

2. FWD - The "Forward" Key causes the system to scan in the direction of increasing wavelength at the preselected speed. When λ is less than λ_2, the system will stop at λ_2. Thus, this key can also be used as a "go to λ_2" key under these circumstances. (No 2 on diagram 2)

3. REV - The "Reverse" Key causes the system to scan in the direction of decreasing wavelength, at the speed selected by the "Scan/Slew" switch. When λ is greater then λ_1, the system will stop at λ_1. Thus, this key can also be used as a "go to λ_1" key under these circumstances. (No 13 on diagram 2)

4. CNT - The "Continue" Key allows a scan that was interrupte by use of the "STP" function to be continued from where it left off. This is particularly useful during a cyclic or repetitive scan. (No 14 on diagram 2)

5. STA - The "Start" Key begins cyclic or repetitive scanning Scanning will take place in the forward direction at the preselected speed until λ_2 is reached, and then return to λ_1 at either the scan or slew speed, depending upon the position of the Scan/Slew switch. Each time that λ_1 is reached in the reverse direction, the number of cycles remaining to be scanned will be decremented by 1, until no scans remain to be done. Important Note: If the number of cycles in the "CYL" register is 0, then pressing the "STA" key will only cause a backlash correction, with no scan taking place. Important Note: For all registers except SPD, the default value is zero. For the SPD registe the default value is the maximum scanning speed. While the system is in the STOP mode, pressing the λ, λ_1, λ_2, SPD or CYL keys, will cause the value in the corresponding register to appear in the display. (No 15 on diagram 2)

6. Scan/Slew Switch - This switch selects the speed for the reverse direction scan. In the slew position, the reverse speed is 1800 Å/min on the HR-320. In the scan position, the reverse speed is the same as the user programmed forwar speed. (With 1200 g/mm gratings) - (No. 16 on diagram 2)

8.5 Function Description - Rear Panel (See diagram 3)

A. Circuit Breaker: If the unit does not operate when power has been turned on, press the circuit breaker switch fully in and release. If circuit breaker continually or repeated opens, contact factory for assistance. (No 1 on diagram 3)

B. On/Off Switch: This switch turns power on for both the control module and the motor. Turning the power switch off will reset all registers to zero. (No 2 on diagram 3)

C. 9-Pin Connector: This connector is used to connect the motor to the control module. See specifications for pin assignment. (No.3 on diagram 3)

D. 5-Pin Connector: This connector is used for interfacing a computer or other external source of control. See specifications for pin assignments. (No 5 on diagram 3)

E. Banana Jacks: These terminals allow for remote recorder starting. When the controller begins the scan, the jacks are "shorted" together. The jacks are off whenever the controller is performing "backlash correction". (No 6 on diagram 3)

8.6 Operation:

Caution: Do not attempt to manually dial the monochromator when the stepping motor is energized. Damage to the monochromator and/or stepping motor may result. The monochromator may be manually dialed as long as the stepping motor is turned off.

A. General Information:

The Microprocessor Scan Controller is designed to allow the user 4 internal modes of scanning plus external (computer) control. These modes are:

Single Scan Forward
Single Scan Reverse
Repetitive Scanning (Scan forward, Slew back)
Cyclic Scanning (Scan forward and back)

1. Single Scan Forward: Pressing the FWD key will cause the system to scan in the forward direction at the speed entered into the SPD register. If λ is less than λ_2 at the start of the scan, the system will automatically stop at λ_2. If is greater than or equal to λ_2, there will be no automatic stop, and the operator must press STP when the desired wavelength is reached. If the monochromator is permitted to scan to the end of its range the controller will lose its wavelength initialization.

2. Single Scan Reverse: Pressing the REV key will cause the system to scan in the reverse direction at either the speed in the SPD register, or the maximum speed, depending upon the position of SCAN/SLEW switch. When $\lambda>\lambda_1$, the system will automatically stop when it reaches λ_1. If $\lambda<\lambda_1$, there will be no automatic stop, and the operator must press STP with the desired wavelength is reached. If the monochromator is permitted to scan to the end of its range, the controller will lose its wavelength initialization.

3. Repetitive Scanning: During repetitive scanning, the monochromat will scan from λ_1 to λ_2 at the user selected speed, and slew back, for 1 to 99 cycles. It is best to start a repetitive scan at λ_1, or the first cycle will not be the same as the rest of the cycles in terms of wavelength coverage. Press STA to start scanning. STP will interrupt the scan. CNT will continue an interrupted scan from the point at which the scan stopped.

4. Cyclic Scanning: During cylcic scanning, the monochromator will scan forward and back from λ_1 to λ_2 at the user selected speed, for 1 to 99 cycles. It is best to start a repetitive scan at λ_1 or the first cycle will not be the same as the rest of the cycles in terms of wavelength coverage. Press STA to start scanning. STP will interrupt the scan. CNT will continue an interrupted scan from the point at which the scan stopped.

5. Backlash Correction: In all four modes of internal operation, there are functions for backlash correction and speed ramping. The backlash correction function enable the controller to remove mechanical backlash from the monochromator and the motor drive system, ensuring accurate wavelength control. This is done by having the motor take number of steps beyond the upper and lower wavelength limits, and then back the same number of steps to resume scanning. During the backlash correction, the controller is considered to be in the "Stop" mode, and thus will not accept any commands from the keyboard. Also, during backlash correction, the recorder remote start jacks are turned off.

6. Ramping: The ramping function consists of an acceleration/deceleration algorithm which takes place during the first and last few steps of a scan operation. This function allows the motor to attain considerably higher scan speeds without any loss of steps. It also prevents the motor from overshooting the destination wavelength during a scan.

B. Setting up the System:

1. Plug the 9-pin connector from the stepper motor module into the rear of the control module.

2. Plug the control module into a 110/120 volt 60 Hz wall outl

3. Turn the power switch on. The motor will immediately do a backlash correction and the wavelength display on the controller will be set to 0. All registers in the controller are also set to zero, except the speed "SPD" register which is set to its maximum value.

4. Set the λ, λ_1, λ_2, SPD and CYL registers to their desired values (see Front Panel description for details).

5. Choose "Scan" or "Slew" speed for the reverse direction.

6. Press the scanning function that is desired:

   FWD Single Scan Forward
   REV Single Scan Reverse
   STA Start Cyclic or Repetitive Scan
   CNT Continue an Interrupted Scan

7. "STP" will interrupt the scan at any time except during a backlash correction.

C. Register Values:

The λ register is the only register whose value will change during the course of a scan. This register, which is updated continuously, changes every time a pulse is issued to the stepping motor.

Any time the motor is stopped, the values of the registers may be checked or changed by pressing the appropriate register key. (See Front Panel function descriptions.)

D. Examples:

1. The monochromator is at 3462 Å. We want to scan from 2000 Å to 5000 Å at 750 Å/min ten times, slewing back in reverse between scans.

Operation	Display	Comments
a. Turn system on	0	
b. Press λ, then CLR	0	Clear λ register
c. Press 3, 4, 6, 2 and 0	3462.0	Initialize
d. Press λ_1, then CLR	0	Clear λ_1 register
e. Press 2, 0, 0, 0, and 0	2000.0	Set λ_1
f. Press λ_2, then CLR	0	Clear λ_2 register
g. Press 5, 0, 0, 0, and 0	5000.0	Set λ_2
h. Press SPD and CLR	0	Clear SPD register
i. Press 7, 5, and 0	750	Set SPD
j. Press CYL then CLR	0	Clear CYL register
k. Press 1 and 0	10	Set CYL
l. Put scan/slew switch to slew position	10	set reverse speed
m. Press REV	starts at 3462.0 scans to 2000.0	Send Mono to λ_1
n. Press STA		Repetitive Scan starts Cycles register will count down to zero as cycles proceed.

At the end of the above scan, the system will be at 2000.0 Å.

2. We now want to scan from 4000.0 Å to 6538.0 Å at 750 Å/min for 25 cycles, scanning in both directions.

a. Press λ_2 then CLR	0	Clear λ_2 register
b. Press 4, 0, 0, 0, and 0	4000.0	Reset λ_2 to 4000.0
c. Press FWD	Starts to 2000.0 Scans to 4000.0	System will scan to 4000 and stop automatically
d. Press λ_1 then CLR then 4,0,0,0, and 0	4000.0	Clear λ_1 reset to 4000.0
e. Press λ_2 then CLR then 6,5,3,8, and 0	6538.0	Clear λ_2 reset to 6538.0
f. Press CYL then CLR then 2 and 5	25	Clear CYL and reset to 2
g. Put Scan/Slew switch to scan position	25	Set reverse speed.
h. Press STA to start scan		

8.7 Computer Interface:

The Microprocessor Scan System will accept external TTL signals for driving the system. The 5-pin connector on the rear of the controller is used for external input. Pin H is ground, Pin D is pulse input for the reverse direction, and Pin E is the pulse input for the forward direction. Each external pulse will cause the motor to take one step in the specified direction. See specifications for the required values.

The LED digital wavelength display will be active during external control and will show the correct wavelength as it "sees" the external inputs and is updated by them.

Specifications:

Power Input	120V 50-60 Hz 50W (Can be changed to 220V input with internal jumper)
Output for Motor	9-Pin connector 166 Hz to 4-chase stepping motor 12V 25W 1V for potentiometer (not available with HR-320) 12V for external power (used for double motor drive)
Computer Input	5-pin connector H=ground D=pulse input positive transition, advances motor in reverse direction pulse length min. 100 micro sec., 0-5V TTL 300 Hz Max. E=Pulse input positive transition, advances motor in forward direction, pulse length min. 100 micro sec., 0-5V TTL 300 Hz max. A=Pulse output, forward direction B=pulse output, reverse direction (A & B can be used for external display of wavelength)
2 Banana Jacks	For remote control of recorder, when stepping motor is in motion, the 2 banana jacks are shorted together.

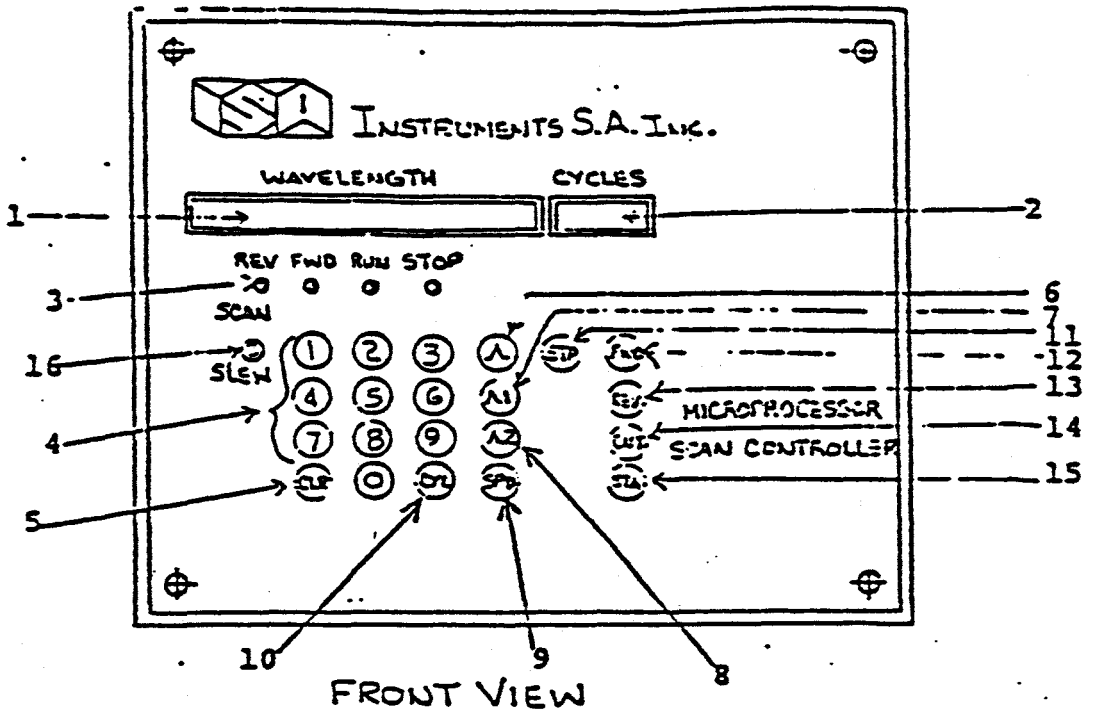
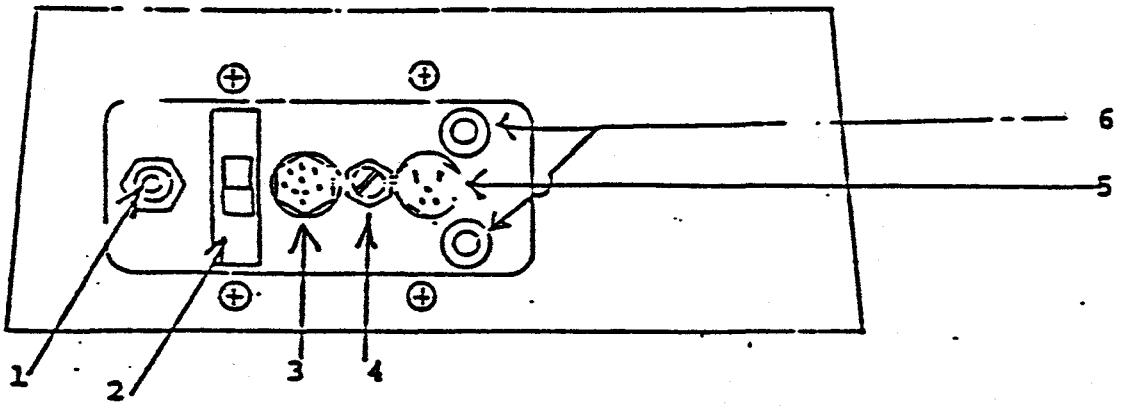


Diagram 2

KEY

1. LED Wavelength Display
2. LED Cycles Display
3. LED Function Lights
4. Black Numerical Keys
5. CLR Key
6. λ Key
7. λ_1 Key
8. λ_2 Key
9. SPD Key
10. CYL Key
11. STP Key
12. FWD Key
13. REV Key
14. CNT Key
15. STA Key
16. Scan/Slew Switch



BACK VIEW

Diagram 3

KEY

1. Circuit Breaker
2. On/Off Switch
3. 9-Pin Connector
4. Potentiometer Adjust
5. 5-Pin Connector
6. Banana Jacks

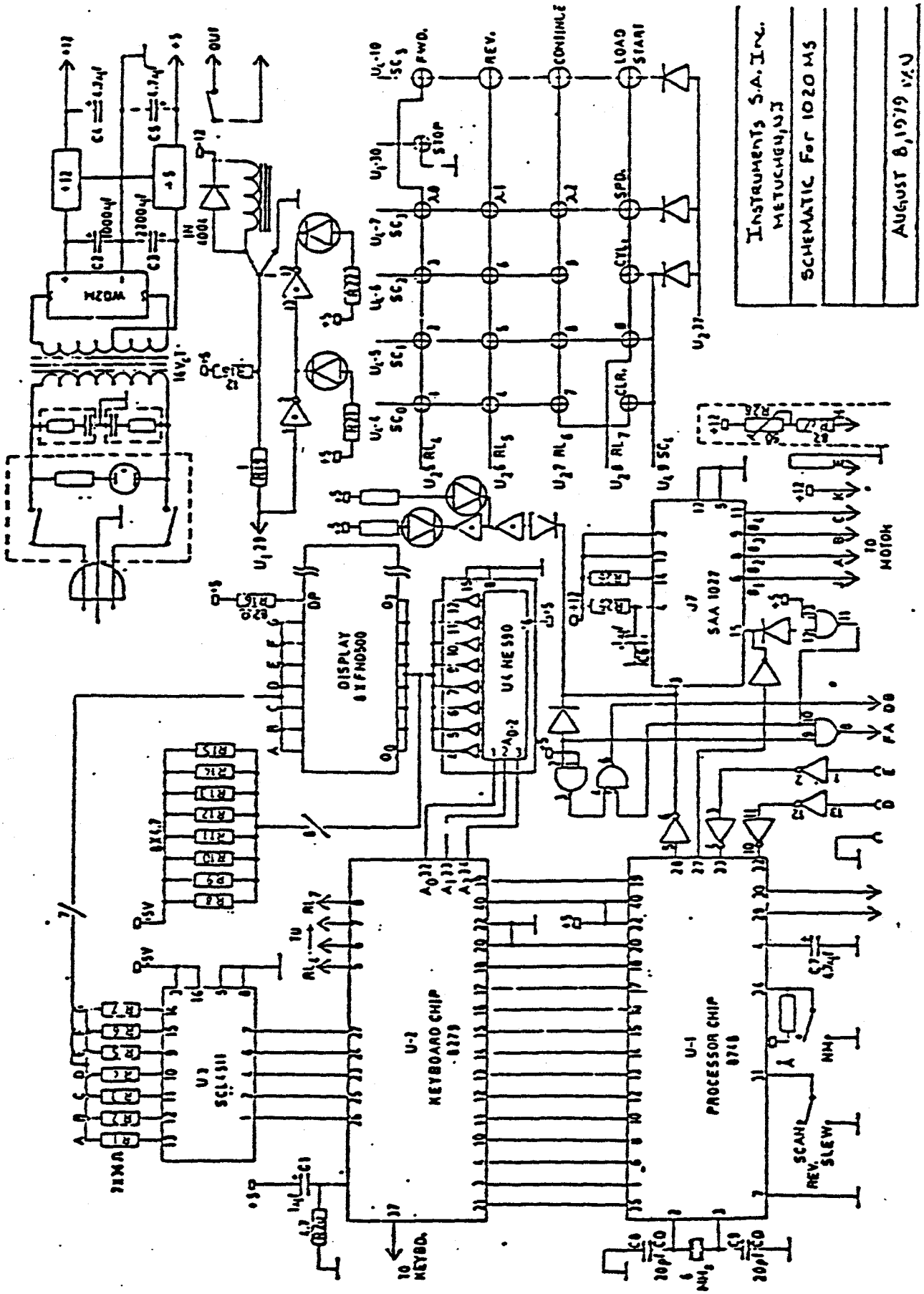

INSTRUMENTS S.A. INC.
METUCHEN, NJ
SCHEMATIC FOR 1020 MS
AUGUST 8, 1979 V4.0
FWD.
REV.
CONTINUE
LOAD START
STOP
SPD.
CTL.
CLR.
DISPLAY 8 SEGMENT
U1 HE 550
J7 SAA 1027
TO MOTOR
PA 08
U-2 KEYBOARD CHIP 8279
U-1 PROCESSOR CHIP 8748
U3 SCL 5511
TO KEYBD.
SCAN
REV.
SLEW

Figure 11

9. WARRANTY

Instruments S.A., Inc. warrants each instrument of its own manufacture to be free from defects in material and workmanship for a period of one year. Obligations under this warranty shall be limited to repair of replacement at our option, of any instrument returned, shipment prepaid, to our factory for that purpose within one (1) year of delivery to the original purchaser, provided prior authorization for such return has been given by an authorized representative of Instruments SA, Inc.

The warranty does not apply if damage to the instrument has been caused by neglect, operation in an adverse environment, or normal wear and tear.

HR-320 MONOCHROMATOR

INSTRUCTIONS FOR INSTALLING GRATING TO ACHIEVE SPECIFICATIONS FOR ALIGNMENT AND LINEARITY

Before starting do not make any counter adjustment since all other gratings have been set for linearity at the factory. The purpose of this instruction is to bring any additional grating to specification at customers location rather than return the instrument to the factor. By movement of new grating to conform to other gratings, this will be achieved.

To Start Procedure:

Install grating in instrument.
Set counter to 1st order green line to 5460 angstroms.
Install light source at entrance slit.
If variable slit opens entrance to approximnately .5mm width, 2mm height, open exit slit to 1.0mm width.
With or without a microscope, look into slit for green line.
Some searching may be necessary to locate green line.
If the image does not fill the entire length of the exit slit, the following must be performed.

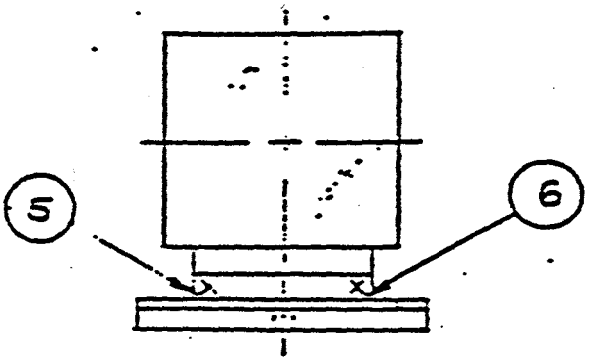
Adjusting Image Tilt:

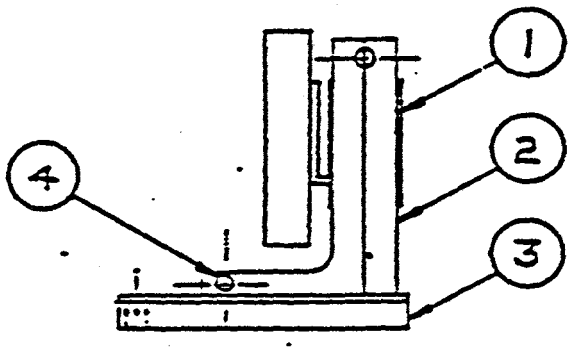
Remove cap seal button in enclosure cover behind grating. This will allow you to have access to the allen set screw in button on grating. By turning screw clockwise, image will move down, counter clockwise, up. This adjustment should be made very carefully. When image is centered the next step will be setting linearity.

Adjusting Linearity:

Keep in mind the counter reading to locate green line again. Return slit openings to 10 microns width and 2mm height. Install PMT or detector at exit slit with photometer and chart recorder. Seek the signal - take note counter reading at highest intensity. If counter reading is higher than actual wavelength, the grating holder must be rotated clockwise by loosening the grating holder lock cap screw only enough for movement. Gently tap holder at bottom near platform at contact point as indicated at position 5. Return to actual wavelength. This adjustment may become tedious if movement is too course. If movement of grating mount on platform is too course, tighten grating holder lock cap screw 4 enough to grab platform pin. The grating mount should not move freely by hand on platform. If signal records at a lower wavelength, adjust with counter clockwise by tapping contact point indicated at position 6. If unable to perform to completion, contact the factory.

HR-320 GRATING MOUNT





1. GRATING TILT ADJUSTMEI SET SCREW.
2. GRATING HOLDER.
3. GRATING PLATFORM.
4. GRATING HOLDER LOCK, CAP SCREW.
5. ADJUSTING AREA FOR HIGH...WAVELENGTH CLOCKWISE.
6. ADJUSTING AREA FOR LOWER WAVELENGTH COUNTERCLOCKWISE.